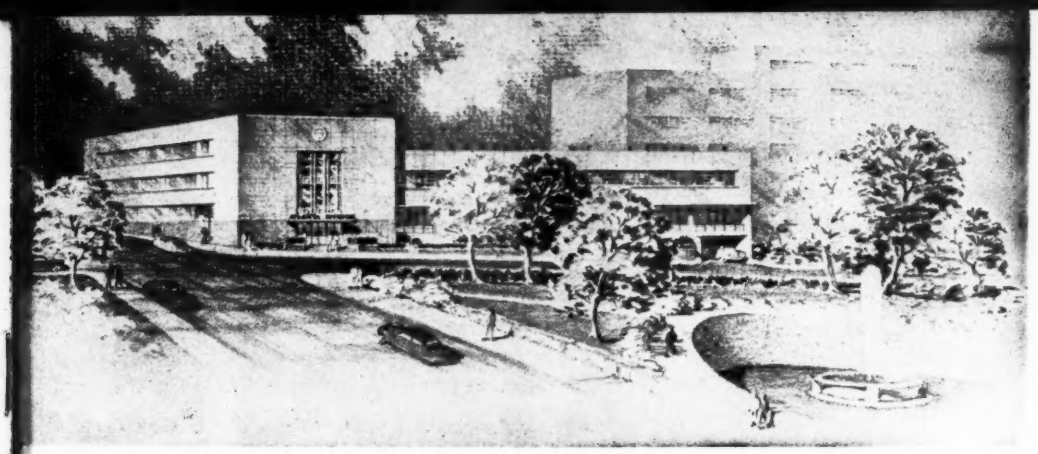

THE ATLANTA ECONOMIC REVIEW

DECEMBER, 1955
VOL. V NO. 12

WATER: A NATIONAL PROBLEM

by

STANLEY A. ARBINGAST*

The United States is a thirsty nation—its citizens are just beginning to become aware of how thirsty it really is. Burgeoning cities, expanding industry, increasing use of air conditioning, recurring drouths, and, above all, rising population are pointing up the necessity for the country to begin planning for its future supply.

Water is the cheapest of liquids because it has been most universally available. However, ever-increasing demands for domestic, industrial, and agricultural use has caused the price of water to soar. Many engineering studies of water supplies have been made, but it is only in recent years that much attention has been paid to the economics of the water problem. As yet, no one really knows enough about water economics to place any exact value on a given quantity, partially because conditions vary from place to place and from industry to industry. However, technologists and economists are beginning to learn much more about the value of this raw material, so essential to both man and industry. They are going to have to study it even more carefully in the future, for an estimated $50 billion dollars has already been invested in facilities for water supply and distribution, and the total spent for such purposes may well rise to over $100 billion by 1975. The days of cheap water are probably gone; increasing competition for it will result in rising costs.

A recent report of the United States Census Bureau forecasts a population of 336 million persons in the nation by the year 2000. Since there are approximately 165 million persons living in the country now, it is obvious that at least twice the amount of municipal water used in 1955 will have to be available for public use by the end of the century. Actually, per capita use is increasing so rapidly that needs may easily triple by 2000. Furthermore, industrial uses will grow concomitantly with the increase in population, thus complicating the situation still further.

When water resources are discussed, most people think only in terms of surface and ground water. This is an over-simplification because water resources are the result of a hydrologic cycle. Moisture which has been evaporated from the oceans moves over the world's land masses, where it falls in the form of rain or snow. Much of it runs off into streams or is drained into lakes and ponds and another substantial portion is drawn down into the underlying geologic formations. Animals, plants, and man use the rest. Completion of the cycle comes when water is returned to the atmosphere (through evapo-transpiration) or is carried back to the sea (an estimated 1,300 billion gallons per day in the United States) by streams.[1] Therefore, when one analyzes water resources of any region, it is essential that he consider the precipitation cycle. Even humid areas are subject to occasional drouths, and an industry or a community which does not remain aware of such significant whims of nature when planning for future water supplies is shortsighted.

Even though we are mining ground water at a tremendous rate, there is enough surface water available for impounding to take care of all the nation's needs far into the foreseeable future. We now use only about one inch of every thirty that falls as precipitation.[2] The problem of supply can be resolved by building dams and by constructing distribution channels adequate to get the water to the right place at the right time. Such schemes,

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1 See Harry B. Kircher's article entitled "One Aspect of Water Resources of the Eighth District" in the **Monthly Business Review, Federal Reserve Bank of St. Louis,** May 1955, for a more detailed discussion of the hydrologic cycle.

2 The United States Geological Survey has calculated an average of 30 inches of rainfall for the nation as a whole. Of this about 21 inches returns to the atmosphere through evaporation and use by vegetation, and 8 inches is run off from the land surface.

however, take tremendous sums of money and years of careful long-range planning. Cities, in particular, will have to depend more and more on surface supplies, for many of them have been pumping heavily from water bearing formations which also supply rural areas.

The failure of the American public to plan for adequate water supplies on other than an emergency basis is the chief reason why so many areas of the nation are now faced with a supply problem. Nature's erratic pattern of precipitation more than any other factor has been the outstanding reason for calling attention to deficiencies in planning. New York City and Dallas, for example, were alerted to the seriousness of the problem because of recent drouths; both cities are now seeking additional water supplies.

But the location of additional water adequate to serve present needs does not solve a city's problem. Each community must carefully analyze its future growth potential and water needs through a comprehensive study of resources available in its immediate area, and through a survey of population trends in the territory it serves.[3] In other words, the possibilities for expansion of the economic base which supports the local population must be thoroughly studied before any logical decision can be made.

Every effort should be made to plan for expanded water use for a half-century in advance; present growth trends in the nation, and the heavy capital investments required to increase supplies, make such planning imperative. The fact that it is obviously impossible to make a completely accurate fifty-year forecast does not remove the need for making a forecast. Making a decision to build a dam (or a series of dams) and to construct distribution lines, for example, implies a forecast. Insisting that forecasting is not worthwhile and then reaching a decision that is in itself an implied forecast has disadvantages over boldly stating the forecasting assumptions on which the decision was based.[4]

During coming years greater emphasis will quite likely be given to making preparation for adding new water supplies by basing planning on river basins as units. Watersheds are natural units for the concentration and channeling of water. A watershed contains cities, farms, and industrial plants—each of whom has a particular interest in how the water funneled into this basin is used, and each has a right to be considered when plans are being formulated. In some instances, however, use of a river basin as a basis for a planning unit may not be possible; for example, Los Angeles already draws on more than one river as a source of supply. In some areas such as the Sabine-Neches watershed in Texas more than one stream may be logically included in a plan. Nevertheless, planning for the effective use of one particular stream is, as a general rule, almost certain to become much more common in the future. A good illustration of such planning is the intensive utilization of the San Joaquin River in California.

Basin-wide plans should not be confined to providing additional water for cities and industries. Flood control, recreation, irrigation, and navigation might all conceivably share in a carefully prepared plan. California's Great Central Valley is an example of an area which has benefited tremendously from a multi-purpose plan, the most comprehensive of its type yet undertaken in the United States. Now in the planning phase is a project aimed at equalizing water distribution in the entire Texas Gulf Coast area through transporting water from the humid eastern section of the region to the semi-arid western extremity of the state's coastal littoral, and a proposal to divert water from surplus areas of the Pacific Northwest into central California has been seriously considered.

There are many road-blocks in the path of any comprehensive basin-wide plan. In particular, con-

3 Engineers, economists, geographers, statisticians, and sociologists, as well as those specifically trained to handle large-scale planning projects, should logically be included on the staff of a planning unit. Each professional group has a particular contribution to make. The recent federally sponsored inter-agency study of the Arkansas-White-Red River basin area of the Gulf Southwest is an example of what can be accomplished through cooperation.

4 John R. Stockton, "Evaluating Water Supply Requirements for a Region," **Journal American Water Works Association**, 45 (May 1953), 459.

ATLANTA ECONOMIC REVIEW

Published monthly by the

Division of Research, School of Business Administration

Georgia State College
of Business Administration

33 Gilmer Street, S. E., Atlanta, Ga.

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flicts between industrial and non-industrial users are to be anticipated. Farmers are usually vociferous in their objections to the flooding of bottom lands by water impounded by reservoir construction. Any reduction in the amount of water available for irrigation draws strenuous opposition from agricultural interests and from local businessmen who fear a reduction in farm income in the immediate vicinity. Furthermore, the general public is often suspicious of the motives of big industry and usually takes the attitude that these manufacturers who receive major benefits from water-conservation projects should be willing to assume the largest proportion of the costs. Also, small cities question the motives of larger cities which reach out a considerable distance beyond corporate limits to draw on available water supplies.

If a river basin is the unit in planning, the interests of up-stream communities often conflict with those situated down-stream. Conservationists, especially those interested in the preservation of wild-life, object to flooding of game refuge areas even though fishing and duck-hunting might be improved. In states the size of California, Texas, and Montana, people who live in the more humid regions often do not understand the seriousness of water supply problems in the more arid portions, and it is difficult to get legislation passed which might benefit one area more than another.

Ideally, local control of water projects should be the goal. However, some projects are so expensive that joint participation with state and/or federal governments is often desirable. Although the financial position of a water district may be favorable, it is frequently difficult for a political unit to secure private financing for a dam which may cost as much as $100 million; in such instances state or federal assistance may be needed. The federal government naturally takes an interest in all projects considered vital to national defense and can be expected to contribute to paying the costs of many projects.

The major use of water in the more arid parts of the nation is for irrigation, water for this purpose being drawn from nearby streams or from wells. Efficient use of water has cut down the total amount needed by as much as 50 percent in some irrigated areas of the West. It has been discovered through experimentation that putting water on fields during the night or on cloudy days reduces evaporation losses tremendously, and that crop yields may even increase, through careful rather than wasteful watering.

It is doubtful that any additional large acreages in the West and Southwest will be placed under irrigation, but expanded use of water for that purpose in the humid areas of the nation is imminent. Farm operators east of the 100th meridian, who have depended heavily on normal rainfall for assurance of a crop in the past, are now irrigating ever-increasing acreages, chiefly through the use of portable light-weight metal or plastic sprinkling systems. Results have been so outstandingly successful that this kind of irrigation may become the normal rather than the exception. In some areas, notably the Southwest, farmers who live near municipal sewage treatment plants have purchased both treated and untreated sewage water, and have used it on their crop and pasture land with exceptionally favorable results.

Manufacturers are deeply concerned with being assured of stable supplies of water for the future, for it is, in many cases, a vital raw material for their operations. Jack Barnes, consulting ground water hydrologist, who wrote the section on ground water resources for the President's Materials Policy Commission, has warned that water supply may be the most important factor affecting the location of industrial plants by 1975. In that year requirements for industrial use may be expected to reach well over 200 billion gallons per day, nearly triple the estimated daily use of 80 billion gallons by manufacturers in 1950. Industries are getting more thirsty with each new year and those which draw on municipal rather than captive supplies have, during periods of restricted supply, imposed heavy strains on the entire municipal system in certain localities.

Some executives of industries which use water in large quantities have conscientiously tried to cut down use wherever possible (an estimated three-fourths of all industrial water is used for cooling or in exchange for heat). Some companies have installed elaborate and expensive water-saving equipment after surveys have demonstrated the possibilities of recirculation and multiple use. Others have experimented with the use of brackish water for cooling purposes. Still others, among them the Cosden Petroleum Company refinery at Big Spring, Texas, and the gigantic Sparrows Point Steel mill near Baltimore, have devised means for utilizing the sewage effluent of nearby cities in cooling and process operations. Through the use of automatic controls and various metering devices, and through proper and accurate record keeping many more companies could cut down their present use substantially. It is worth noting, however, that many industries only take a loan of water; they use it and then discharge it in quality good enough for intake by some other industry situated down-stream. Industries which decompose large quantities of water are not numerous.

Industry not only has a sizable stake in securing an adequate and stable supply of water for its needs, but it has an obligation to cooperate with local, state, and federal authorities in securing the supply. It also must use water intelligently; efficient use and reuse is mandatory, and pollution of

OCTOBER
ATLANTA AREA ECONOMIC INDICATORS

ITEM	October 1955	September 1955	% Change	October 1954	% Change
EMPLOYMENT					
Job Insurance (Unemployment) Payments	$191,152	$203,343	−6.0	$309,870	−38.3
Job Insurance Claimants†	3,959	3,310	+19.6	4,842	−18.2
Total Non-Agricultural Employment	323,000	319,900*	+1.0	301,650*	+7.1
Manufacturing Employment	90,850	90,200*	+0.7	79,250	+14.6
Average Weekly Earnings, Factory Workers	$69.53	$68.61	+1.3	$63.04	+10.3
Average Weekly Hours, Factory Workers	40.9	40.6	+0.7	39.9	+2.5
Number Help Wanted Ads	11,168	11,516	−3.0	7,717	+44.7
CONSTRUCTION					
Number of Building Permits, City of Atlanta	858	868	−1.2	763	+12.5
Value Building Permits, City of Atlanta	$3,408,257	$7,409,084	−54.0	$5,181,868	−34.2
Employees in Contract Construction	20,600	21,150*	−2.6	18,000	+14.4
FINANCIAL					
Bank Debits (Millions)	$1,496.8	$1,465.6	+2.1	$1,351.9	+10.7
Total Deposits (Millions) (Last Wednesday)	$1,078.6	$1,043.1	+3.4	$1,011.6	+6.6
POSTAL§					
Postal Receipts	$1,596,761	$1,475,002	+8.3	$1,506,167	+6.0
Poundage 2nd Class Mail	1,508,720	1,439,524	+4.8	1,539,777	−2.0
OTHER					
Department Store Sales Index (Adjusted) (1947-49=100)	141	150	−6.0	144	−2.1
Retail Food Price Index (1947-49=100)	110.1	111.1	−0.9	111.5	−1.3
Number of Telephones in Service	267,962	266,292	+0.6	252,245	+6.2
Number of Local Calls Per Day	1,841,290	1,835,550	+0.3	1,761,362	+4.5

*Revised
§City of Atlanta only.
†Claimants include both the unemployed and those with job attachments, but working short hours.

Sources: All data on employment, unemployment, hours, and earnings: Employment Security Agency, Georgia Department of Labor; Number Help Wanted Ads: Atlanta Newspapers, Inc.; Building permits data: Office of the Building Inspector, Atlanta, Georgia; Financial data: Board of Governors, Federal Reserve System; Postal data: Atlanta Post Office; Retail Food Price Index: U. S. Department of Labor; Department Store Sales and Stocks Indexes: Federal Reserve Bank of Atlanta and Board of Governors, Federal Reserve System; Telephones in Service: Southern Bell Telephone and Telegraph Company.

JANUARY THROUGH OCTOBER, 1954 and 1955

1955	1954	ITEM	% Change
19,510	15,500	No. Construction Employees*	+25.9
$14,164.2	$12,639.8	Bank Debits (Millions)	+12.1
N.A.	N.A.	Department Store Stocks**	+12.0
86,695	78,135	No. Manufacturing Employees*	+11.0
9,344	8,461	Number Building Permits, City of Atlanta	+10.4
74,318	67,686	Number Help Wanted Ads	+9.8
$67.58	$62.55	Average Weekly Earnings, Factory Workers*	+8.0
$1,078.6	$1,011.6	Total Deposits (Millions)**	+6.6
267,962	252,245	Telephones in Service**	+6.2
13,930,761	13,120,850	Poundage 2nd Class Mail, Atlanta Post Office	+6.2
311,710	296,235	Total Non-Agricultural Employment*	+5.2
$14,411,880	$13,879,646	Postal Receipes, Atlanta Post Office	+3.8
40.6	39.7	Average Weekly Hours, Factory Workers*	+2.3
N.A.	N.A.	Department Store Sales, Based on Dollar Amounts**	+2.0
110.1	111.5	Retail Food Price Index (October)	−1.3
$69,558,022	$73,500,044†	Value Building Permits, City of Atlanta	−5.4
42,805	56,271	Job Insurance Claimants	−23.9

†Special ruling permitted construction of $20,500,000 Grady Hospital addition without permit. If included, total above is $94,000,044. and the change becomes minus 26.0%.
*Average Month
**End of Month
N.A.—Not Available
Sources: Same as page 4.

streams must be guarded against, especially those which are drawn upon by down-stream industries. As local shortages develop, industrialists can and should contribute statesmanlike leadership in solving community water problems; manufacturers have important obligations to their local community as well as to their own industry.

Factories require water for two purposes—process and sanitation. The latter use is in most cases rather unimportant because it is confined to water consumed in the plant cafeteria, lavatories, and laundry, and to that consumed for drinking purposes. Industrial water does not need to be as pure as sanitary water except for that which is used in the preparation of food or pharmaceuticals. Water which has been labelled as contaminated for domestic consumption can be used by most industries.

In 1953, the Bureau of the Census surveyed all manufacturing establishments using 20 million or more gallons a year. Intake for these plants totalled 11.4 trillion gallons and over 2 trillion of this amount was brackish. Public water systems provided about 20 percent of the intake of fresh water and the rest came from company-owned surface and ground water systems. The tabulation showed that Pennsylvania, Ohio, and Texas were the three largest users; these three states are centers of concentration for the chemicals, primary metals, and petroleum and coal products industries, all large consumers for manufacturing purposes. If it had been feasible to secure an accurate report on all water used in factories, the total would have been substantially greater.

Table I has been compiled to show how much water is used per unit of product in selected industries. Of course, total amount utilized per unit varies from plant to plant because equipment and processes vary; some plants are more modern than others and many companies are more conscientious in their use of water. In general accurate information on the amount used to make a unit of product is very limited because, until recently, demand did not equal or exceed supply and such figures were of minor value. Industries should not balk at making present needs or uses known for increasing attention to such statistics is now fundamental if future demands for industrial water are to be anticipated with any degree of accuracy.

In addition to the construction of more dams, the utilization of brackish water and sewage effluent, and the implementation of rigid water conservation practices there are other ways to combat water shortages, some of which offer real promise for substantial help. Much interest is now being shown in projects designed to recharge underground reservoirs and aquifers. One of the more significant of such experiments is now underway

TABLE 1

ESTIMATED WATER USE PER MANUFACTURED UNIT, SELECTED PRODUCTS*

Product	Amount of Water Used
Bleached cotton goods (ton)	60,000-80,000 gallons
Viscose yarn (ton)	200,000 gallons
Aluminum (ton)	2,000,000 gallons
Sulfuric acid (ton)	2,500-5,000 gallons
Soda and sulfite pulp (ton)	60,000 gallons
Synthetic rubber (ton)	600,000 gallons
Refined petroleum (barrel)	770 gallons
Synthetic ammonia (ton)	30,000-35,000 gallons
Refined Steel (ton)	40,000-50,000 gallons
Lima beans (100 cases)	25,000-30,000 gallons
Meat (100 hogs)	55,000 gallons
Portland cement (ton)	750 gallons
Hydrogen (ton)	600,000-700,000 gals.
Caustic soda (ton)	18,000-25,000 gallons
Laundry soap (ton)	200-500 gallons
Refined vegetable oils (gallon)	20-25 gallons
Soda ash (ton)	15,000-25,000 gallons
Beer (barrel)	300-500 gallons
Steam (per ton of coal consumed)	100,000 gallons
Bromine (ton)	5,000,000 gallons

*These estimates were made after examination of a large number of published materials. In some instances estimates varied rather widely and in others the majority of sources were in very close agreement. It should be emphasized that additional water is used for purposes of providing steam for the manufacture of many of the products listed above.

on the gigantic King Ranch in Southwest Texas, an area frequently plagued with severe drouths. Owners of the ranch have constructed a 1,500-acre lake for the purpose of impounding water from runoff after heavy rains, and then pumping it into the ground to replenish depleted aquifers which supply wells on more distant portions of the ranch. As yet heavy rains have been too infrequent to draw any accurate conclusions concerning the value of such a practice in the Gulf Southwest. In California experiments of this nature have proved quite successful, and use of the recharge technique has become rather common. Many other experiments on a smaller scale have been tried in various parts of the nation, with results being favorable for the most part.[5]

A much talked about method for overcoming water shortages in some sections of the nation is saline water conversion. Extensive areas are underlain with deposits of salt brines, which might conceivably be treated and made potable or at least treated in such a way as to make them pure enough for utilization by factories. Scientists are generally agreed that it is not unreasonable to assume a method will be discovered to make saline conversion practical in inland areas. Development of a method to treat brines would be a boon to vast areas of the West, where quality as well as quantity of supply

5 For a more comprehensive discussion of water recharge see Grant Cannon, "Refilling Our Wells," **The Atlantic Monthly**, 194 (August 1955), 46-49.

(Continued on Page 8)

PRODUCT CHANGES—AN IDEA

by

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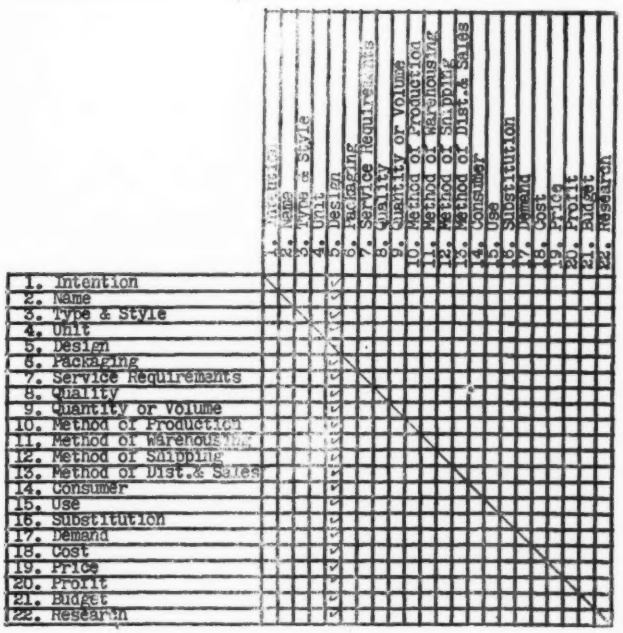
The problem which a company faces when making any changes in a product is anticipating what the effect of these changes will be, and that company which best anticipates the effects of the changes maximizes its opportunity. While the analysis of proposed changes and their effects can involve considerable work, a quick yet inclusive examination can be made with a product interaction chart such as the one illustrated in Figure 1.

This product interaction chart combines the check list with the idea often used in intercity mileage charts printed on highway maps. Twenty-two aspects of a product that might be changed are listed vertically and horizontally as 22 cities might be listed vertically and horizontally on a mileage chart. A check may then be placed in the squares below any one of the 22 items that might be changed as that change is checked against the remaining 21 aspects of the product.

Given a definition of each term as it applies to a particular company's product (or if necessary changing the terms or adding others), an executive can check off the possible effects or interactions of any change in policy of his company—or of competition, the market, or the government. For example, the product interaction chart could be used to raise relevant points in the appraisal of the possible effects of a new design in a company product. One would look across the horizontal list till he reached the column in which the word "design" appears. This would be column 5. One would then go down the column and place a check in each square as the proposed design is checked against each of the aspects: (1) Intention—What is the purpose of the new design? (2) Name—Would the new design have a new name? Would it require a new brand, label, trademark, or license? Does it fit into the current "family" of product names or will it require a distinctive title? (3) Type and Style—Will the new design change the type or style of the product or its general classification by the market? (4) Packaging—Does the new design require a new unit of measure in manufacturing? And in a similar manner the design could be checked against the remaining aspects on the chart.

Such a brief run through of a proposed change in a product design would give an executive a pretty fair idea of what he was getting into and indicate **all** of the company's major operations which might be affected by the change. Any other change concerning the product may be examined in the same way such as increases in the cost of raw materials, competition from a new product, or a change in the law governing warehousing. Of course, the product chart in most cases would have to be made up in terms of each company's operations. A retailer or service establishment would tend to have a considerably different list of items than a manufacturer. The author has had occasion to develop a chart with 207 items.

The utility of a product interaction chart is very high and can prove most helpful to management in considering the effects on a company of proposed changes by the company in its policy or the effects of changes that have or may take place outside of a company.



Product Interaction Chart

Figure 1

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of Business Administration
33 Gilmer St., S. E.
Atlanta 3, Georgia

RETURN POSTAGE GUARANTEED

is often a serious handicap to the growth of cities and the expansion of irrigation.

Researchers have long looked upon the ocean as a supplementary source of water. When more is learned about nature's process of changing salty sea water into fresh vapor which in turn falls as precipitation, technologists will be closer to the accomplishment of a method which will make large-scale conversion of salt water economical. As yet only small scale conversion in areas of extremely low rainfall[6] or for use on ocean-going vessels has been found practical because conversion costs usually average about $1.20-1.50 per thousand gallons. Some cities, especially those in dry areas where higher prices are justified, have been willing to pay as high as 30-35 cents per thousand gallons, but a price of 5-10 cents per thousand is usually about the highest price that is economically acceptable. However, just getting the cost of purified sea water down to a level low enough for the average purchaser will not completely solve the problem for a method will have to be devised for low cost transportation of the converted water from the point of treatment to the hinterland where needs are often greatest. Steep gradients in some regions may cause costs of delivery to be exceptionally high.

Inducement of artificial precipitation through seeding of clouds with silver iodide or dry ice may prove to be practical, but until the answers to many legal and scientific questions are clarified, the use of such a method is questionable. Many carefully controlled experiments in this vital area of research are now underway; evidence gathered so far is inconclusive.[7]

As our nation grows and develops, and as the living standards of its citizens continue to rise, the problem of adequate water supply will become concomitantly more serious. Leadership will have to be provided by scientists, business executives, and other public spirited citizens, and it is essential that long range plans for solution of the problem be formulated now—delay may be costly.

6 The island of Curacao in the Dutch West Indies and Kuwait on the Arabian peninsula are examples of water short areas which have made effective use of distillation units.

7 Sidney Gottley, "Water" a chapter from **Mineral Facts and Problems**, preprint from Bulletin 556, Bureau of Mines, United States Department of Interior, 6.